REMARKS/ARGUMENTS

The invention is directed to a method for predicting an amount of dimensional accuracy defect when press forming a metal sheet. Such defects can be classified as either a wall warp amount ρ or an angular change amount $\Delta\theta$. The dimensional accuracy defect amount is the result of elastic recovery behavior following the bending and drawing of the material, which bending and drawing comprises a combination of plastic and elastic deformation.

The standard analysis of the plastic and elastic deformation of a material is graphically shown in Figure 5, which illustrates that the application of stress produces strain in the elastic deformation region up until a yield point σ_p is reached, followed by plastic deformation corresponding to work hardening until the tensile strength of the material is reached. The invention is based in part upon the recognition that complexities in the conventional techniques for predicting an amount of a dimensional accuracy defect have resulted from the need to take into consideration the plastic deformation corresponding to work hardening (page 13, lines 7-22). Therefore, in order to simplify the prediction equation, the inventors have recognized that one can begin with a stress-strain relationship which ignores the portion corresponding to work hardening, i.e., one assumes a plastic material whose stress keeps a fixed value after yielding at the yield point σ_p (i.e., an "elastic-perfectly plastic solid material"). This is shown in Figure 6 and described in the paragraph bridging pages 13-14 in the specification.

Based upon this assumption, the amount of wall warp ρ amount due to elastic recovery after a bending/unbending deformation can be expressed according to equations I or II on page 14 of the specification. As is evident from these equations, the amount of wall warp ρ is a function of the yield point σ_p.

On the other hand, the present inventors have also recognized that the wall warp amount calculated according to the above equations I, II is the product of an over-simplification and does not sufficiently simulate the actual wall warp deformation. Therefore it is necessary to take the work hardening into consideration to some extent (page 20, lines 11-21). Accordingly, referring to Figure 12 and the paragraph bridging pages 20-21 in the specification, it was found that by setting an apparent yield stress value $\sigma_{p'}$ which is equal to or less than the tensile stress and exceeds the yield stress yield point σ_p, and adding this to the predicted wall warp amount, a more accurate dimensional accuracy defect prediction can be achieved. More particularly, Figure 12 indicates that the apparent yield strength $\sigma_{p'}$ is a value which is greater than the yield strength σ_p but less than the tensile strength of the material, and may be set according to equation 1 on page 22 of the specification. Accordingly, by modifying equation II as equation II" (page 23), which replaces the yield stress value σ_p with the apparent yield stress value $\sigma_{p'}$, a more accurate value of the wall warp defect ρ can be predicted (page 23, lines 2-11). Similarly, a value of the angular change amount $\Delta\theta$ can also be predicted using the apparent yield strength (page 26, lines 13-22).

In view of the above explanation, it may be appreciated that the claims are in fact sufficiently clear under 35 U.S.C. § 112 and that the specification provides proper antecedent basis for the claim subject matter. For example, referring to the steps of Claim 1 and the non-limiting embodiment in the specification, the step of setting a stress-strain relationship with respect to the sheet material based on an elastic perfectly plastic solid material model having a constant stress value after being yielded may be exemplified by the Young's modulus "E" in Figure 6. The first prediction equation based on the elastic perfectly plastic solid material model may be exemplified by equations I or II on page 14 which use the yield strength σ_p. The step of setting a value which is equal to or below a tensile strength and exceeds a yield strength as an apparent yield strength with respect to the metal sheet may be exemplified by

setting the apparent yield strength $\sigma_{p'}$ based upon equation 1 on page 22. The step of formulating a second prediction equation by replacing a portion of the first prediction equation with the apparent yield strength can correspond to equation II" on page 23, which uses the apparent yield strength $\sigma_{p'}$ rather than the yield strength σ_p. Finally, solving equation II" exemplifies the step of obtaining a dimensional accuracy defect amount using the second prediction equation. Applicants therefore respectfully submit that the subject matter of Claims 1-9 would have been clear to those skilled in the art at the time of invention and in light of the specification, and so respectfully request that the rejection under 35 U.S.C. § 112 and the objection to the specification be withdrawn.

Since no prior art rejections have been applied, Applicants respectfully submit that the present application is in a condition for allowance and request an early notice of allowability.

Respectfully submitted,

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